

Pyrolysis-GC/MS System for Microplastics Analysis

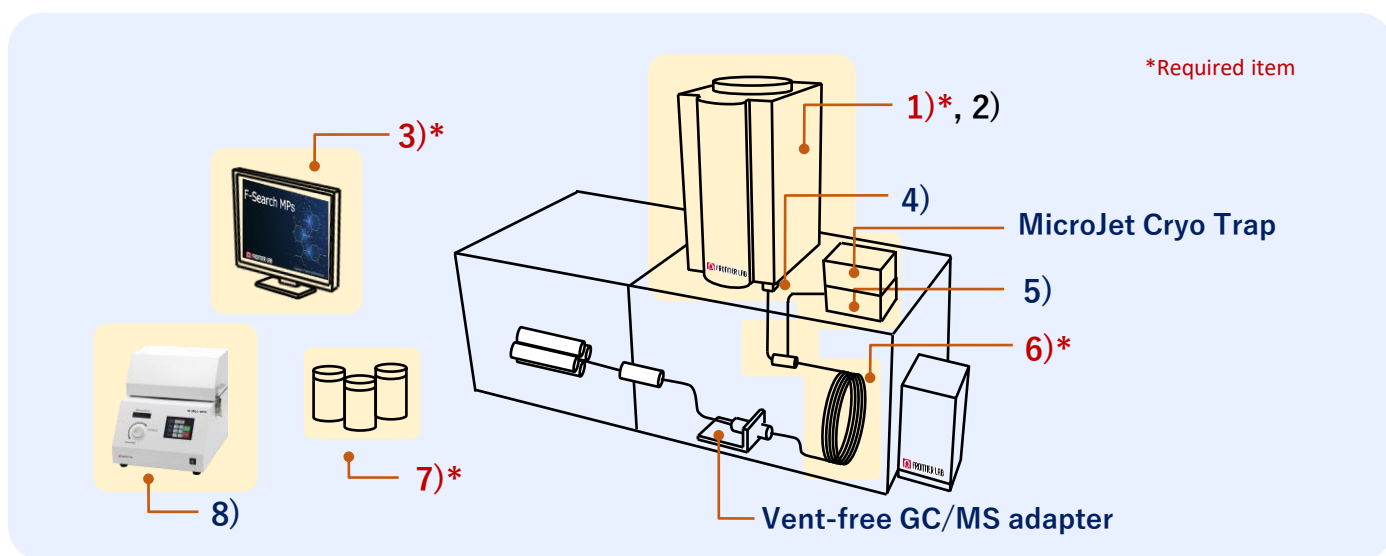


Micro-Furnace Pyrolysis-GC/MS System Tuned for Microplastics Analysis

Pyrolysis (Py)-GC/MS enables direct analysis of solids and liquids to determine the formulation and chemical structures of the samples. This technique can be applied to samples that are insoluble due to the large molecule and/or cross-linked structure. This technique requires minimal sample preparation and only a small amount of sample for analysis. It even generates unique information about each polymer while other analytical techniques do not share this capability. Therefore, Py-GC/MS is a critical technique for plastics analysis.

We have developed a Micro-Furnace Py-GC/MS system optimized for the analysis of microplastics in environmental samples. With special data analysis software, even analysts with little experience in polymer analysis can easily utilize this technology in your laboratory. The analysis procedure, including identification and quantification, is automated, and results can be obtained in less than one hour per sample.

This system consists of a GC/MS system and accessory devices shown below.



1) Multi-Shot Pyrolyzer (EGA/PY-3030D)

A vertical micro-furnace pyrolyzer based on a ceramic heater. Sample heated in the furnace forms gaseous pyrolyzates which are directly introduced into the GC.

3) F-Search MPs *

*JPN patent 6683335

The unique search algorithm allows users with little experience in polymer analysis to obtain reliable microplastic identification and quantification results.

5) Multi-functional Splitless Sampler (MFS-2015E)

It enables the splitless pyrolysis** that greatly improves the detection sensitivity of pyrolyzates. The backflush shortens analysis time and reduces system contamination.

**MicroJet Cryo Trap is required

7) Microplastics Calibration Standard Set

This kit is used to identify and quantify 12 major polymers using Py-GC/MS. It also allows to easily create calibration curves for quantification of MPs.

2) Auto-Shot Sampler (AS-1020E)

The Auto-Shot sampler automates a continuous series of analyses of up to 48 samples. This feature saves labor and improves reliability.

4) Packed GC Glass Insert

The peak shape of the pyrolyzates of polymer is improved, resulting in better qualitative and quantitative accuracy of the plastic species using F-Search MPs 2.0.

6) UAMP Column Kit

It improves the peak separation of a specific plastic in polymer mixture samples while reducing the contamination of the separation column.

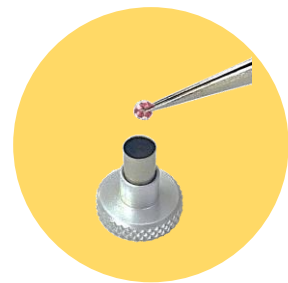
8) Cryogenic Mill (IQ MILL-2070E)

It is a compact benchtop grinding mill with powerful and shear crushing capabilities. Also, it makes the sample grinding process into a simple pre-treatment operation.

Workflow for Microplastics Analysis with Micro-Furnace Py-GC/MS System

Step 1 Sampling and pretreatment

Microplastics are extracted from environmental samples by appropriate pretreatment and then homogenized using Cryogenic Mill (IQ-MILL 2070E) or a mixer. The sample is then placed in a sample cup and weighed using a semi-micro balance.



Step 2 Set of the sample cup on the Auto-Shot Sampler

The sample cups are placed onto the Auto-Shot Sampler. Up to 48 cups can be loaded each time.



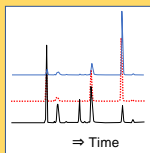
Step 3 Pyrolysis of the sample

The sample is introduced into the Micro-Furnace pyrolyzer by the Auto-Shot Sampler and is pyrolyzed. The plastics become pyrolysis products (pyrolyzates) and are introduced into the GC directly. On the other hand, the inorganics in the sample remain in the sample cup as residues.



Step 4 GC/MS analysis

Pyrolyzates are separated on a GC column and detected by a single Quadrupole mass spectrometer. The resulting pyrogram generally includes a peak for each pyrolyzate. The mass spectrum from each peak reflects the chemical structure of each pyrolyzate. Each polymer generates a unique set of pyrolyzates.



Step 5 Data analysis

Reliable and quick Data analysis can be done using F-Search MPs. Calibration curves are created automatically based on the analytical results from the reference polymer mixture. Then F-Search MPs performs quantitative calculation automatically and results are reported for each sample.

Polymer	Prob. [%]
PE	99.9
PVC	95.9
SBR	10.5
PP	91.7
PS	99.6
PET	88.6
PMMA	99.9
PU	99.9
ABS	70.2
N66	95.1
N6	74.2
PC	70.7

Identification/Quantitation Analysis of Microplastics with F-Search MPs

The F-Search software results screen shown below identifies the detected plastic types, displays the match quality for the library search, and lists quantitation interpretation. All information can be seen at a glance. The Mass Chromatogram and Mass Spectrum of a sample are shown side by side on the screen in comparison with the Mass Chromatogram and Mass Spectrum of the library reference.

